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Optimizing Sambar Deer Breeding Management: A Case Study at the Bpsilhk Aek Nauli Breeding

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The sambar deer, an endemic animal to Indonesia, is protected by Government Regulation Number 7 of 1999 and is listed as "Vulnerable," according to the IUCN, indicating its vulnerability to extinction. The main objective of this research is to analyze the current management of sambar deer breeding, identify supporting and inhibiting factors, and plan strategies to improve management by ideal standards. Data for this research was collected through literature study, observation and interviews. The sample of respondents was selected from actors or stakeholders who have the most significant role in the management of this deer breeding area, including the head of the service (1 person), head of the planning section (1 person), team member (2 people), and guard (1 person). The form of captive management was analyzed using a Likert scale, supporting and inhibiting factors were analyzed using descriptive analysis, and the form of management strategy was analyzed using SWOT analysis. The results obtained were that the sambar deer breeding management had a score of 3.90, or the management was quite good. Supporting factors for management are the breeding area, which is still sufficient to accommodate many deer, complete equipment and cage equipment in the cages, and healthy deer. Moreover, the inhibiting factors for management are the unavailability of veterinarians and the fact that data on recording sick sambar deer needs to be well documented, making it challenging to monitor health. Recommendations for the management strategy for sambar deer breeding at BPSILHK Aek Nauli is an alternative SO *(Strength-Opportunity) strategy* obtained, namely: Caring for the cages together with the community, utilizing the area of the cage to add deer, utilizing breeding locations located in tourist locations and caring for the deer so that always healthy.

Keywords: Sambar deer, Captivity, Deer management, Animal husbandry, Endemic species, IUCN Red List, Vulnerable species, Captive management, Supporting factors, Breeding area, SWOT analysis.

INTRODUCTION

Sambar deer, one of four types of deer in Indonesia, are protected by Government Regulation Number 7 of 1999 because their population has experienced a decline of up to 10% in the last 15 years. Currently, sambar deer are in the "Vulnerable" category according to the IUCN, with their primary habitat in Sumatra and Kalimantan. Even though they are the most significant type of deer in the tropics, they are often the target of hunting because of their popularity. Illegal hunting activities and habitat destruction are the main factors in the decline in the sambar deer population in Kalimantan and Sumatra (Widjaja and Utomo, 2021; Gubbi and Linkie, 2012; Haleem and Ilyas, 2023).

Sambar deer are a key species and a top priority in increasing population numbers (Haleem and Ilyas, 2023). Therefore, the Center for the Implementation of Standard Environmental and Forestry Instruments, abbreviated (BPSILHK), plays a vital role in maintaining the survival of sambar deer in the Aek Nauli area. One of the efforts is establishing a sambar deer sanctuary as a priority animal for ex-situ conservation management in Sibaganding Village, Girsang Sipanganbolon District, Simalungun Regency. Ex-situ conservation or deer breeding helps increase populations, protecting genetics, supporting ecotourism, reintroduction and increasing public awareness.

The importance of sambar deer breeding management for future sustainability emphasizes the need to know good and

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optimal management. Until now, no complete data has been available regarding the management of breeding sambar deer at the BPSILHK Aek Nauli sanctuary. Is it appropriate or not? This research is interesting to carry out so that the management of sambar deer breeding is based on the ideal breeding concept. The main objective of this research is to analyze the current management of sambar deer breeding, identify supporting and inhibiting factors, and plan strategies to improve management by ideal standards.

MATERIALS AND METHODS

The research was carried out at the sambar deer breeding owned by BPSILHK in Aek Nauli, Simalungun Regency, North Sumatra. The time for field data collection was carried out in October - December 2023. The tools used in this research are Cameras used to document observations made and writing instruments used to record the data obtained. Meanwhile, the object of this research is sambar deer. The data collected is adjusted to habitat components based on Krausman and Cain (1985), with minor adjustments in areas such as Food, protection, water, and health.

The data collection method uses literature study, observation and interviews to determine the sample of respondents selected from actors or stakeholders who have the most significant role in managing the deer breeding area, including the head of the department (1 person), head of the planning section (1 person), employees (2 person), and guard (1 person). A literature study was carried out to obtain secondary data and aspects of general breeding activities through document searches. A literature study was carried out to sharpen and strengthen the validity of the analysis. Field observation is the collection of data on aspects of breeding techniques carried out by directly observing conditions in the field on a 1-5 Likert scale, where ratings are given 1 (very poor), 2 (Poor), 3 (Fair), 4 (Good) and 5 (Very good). Interviews were conducted with cage officers and sambar deer breeding managers regarding information on management techniques for sambar deer breeding at BPSILHK Aek Nauli.

The sampling technique is to obtain and explore information and knowledge from stakeholders and experts, using the expert survey method through in-depth interviews with purposive sampling. Purposive sampling is a deliberate technique by researchers from an informant based on the qualities of the informant (Douglas, 2022; Johnson *et al.*, 2020). In this research, the data analysis used are descriptive analysis and SWOT analysis.

RESULTS AND DISCUSSION

***General Conditions of the Area and History of Sambar Deer Breeding*:** Deer breeding is located in the Forest Area with Special Purposes (KHDTK), included in the Agency for the Implementation of Standards for Environmental and Forestry Instruments (BPSILHK). Aek Nauli is one of the KHDTKs established through the Decree of the Minister of Forestry No. 39/Menhut-II/2005, dated 7 February 2005, with an area of 1 900 Ha. Geographically, KHDTK Aek Nauli is located between 2˚ 41' - 2˚ 44' N latitude and 98˚ 57' - 98˚ 58' E longitude and administratively, it is included in Sibaganding Village, Girsang Sipanganbolon District, Simalungun Regency. The sambar deer breeding area has an area of 0.4 hectares. The ecosystem types found in KHDTK Aek Nauli can be grouped into Primary Forest, Secondary Forest, Plantation Forest/Pine Dominance, Shrubs and Grass (Situmorang *et al.*, 2020; Latifah & Panggabean, 2023).

The BPSILHK Aek Nauli sambar deer farm was established in 2018 based on permission from the North Sumatra Natural Resources Conservation Center. With an area of 0.4 hectares and six deer, this breeding started operations in 2019 with the arrival of two deer from Aceh and Jambi, named Tanggu and Nauli. The primary purpose of this sanctuary is as a conservation center to preserve sambar deer and as a vehicle for research and development of animal breeding technology. It is also hoped that this breeding can become an educational tourism destination for the local community. In the long term, it is hoped that the development of captive breeding will support the cultivation and trade of sambar deer as a promising economic commodity.

***Aspects Of Captive Management (the aspect of the cage)*:** The area of the sambar deer enclosure at BPSILHK Aek Nauli is 0.4 hectares, filled with six individual deer, which means that one deer has an area of 285.7 meters/head. Judging from the area of this enclosure with a ranch enclosure model, the ranch enclosure model for the six individual sambar deer bred in Aek Nauli is deemed adequate. This is to the statement by Jensen *et al.* (2023) that the ideal size of a ranch pen model for ten individual deer is a land area of 1 ha or 10,000 m^2; sambar deer can live and reproduce in captivity optimally with a minimum area of 250 meters/head. The cage is constructed according to the animal being kept. It is essential to pay attention to this so that the animal cannot get out of the cage and that it is safe for visitors who come to see it from the edge of the cage. Every morning and evening, the cage is cleaned by sweeping up the Food scattered around the feed area. The water tub is cleaned 1-2 times a month by brushing the bottom and then replacing it with new water. The condition of the deer's drinking water at the time of the observation was quite good; the water flowed from a pipe channelled directly from a spring around the forest area and was slightly mossy at the bottom of the tank. Enclosure facilities are an essential component supporting the comfort of sambar deer in the enclosure. The sambar deer breeding cage facilities at BPSILHK Aek Nauli include shade buildings for the deer to take shelter and rest, shade trees for the deer to take shelter and a place to sharpen the antlers, a

feeder so that the ground does not soil the food and is not stepped on by the deer. This water pool functions as a drinking place for the deer, observation tower as a research facility for academics who want to conduct student research. The purpose of observing aspects of the enclosure is to assess whether the enclosure that has been used is ideal enough to accommodate deer. From the results of direct observations in the field, it can be concluded that the aspects of the breeding enclosure have met the desired standards with a rating scale of 4 (good) with the analytical statement: The deer enclosure has been well maintained and provides a safe environment for the animals. However, some areas need minor improvements to improve deer comfort and safety.

***Aspects of Captive Management (Feed Aspect)*:** According to the results of research conducted by (Umardi *et al.*, 2024; Gurung, 2022; Crider *et al.*, 2015) stated that food is the most critical component; the leading food for sambar deer is forage in the form of leaves and grass. Forage is food in the form of leaves, sometimes mixed with stems, twigs and flowers. Sambar deer need forage and concentrate so that to fulfill the food for sambar deer at BPSILHK Aek Nauli, the manager or officer provides essential food and additional food. Using motorbikes, sambar deer feed is taken daily in 70 kg around the BPSILHK Aek Nauli forest. The feed given to sambar deer twice daily is 35 kg in the morning and evening, divided into two feed areas. The feed trough is cleaned twice daily before feeding; the dry feed will be separated and discarded. It is a barrier to animal survival because food is a source of energy for animals to carry out activities and reproduce. The type of food given by sambar deer in captivity consists of primary and additional food. According to research results by Averill *et al.* (2016); Arcese *et al.* (2014); Lavelle *et al.*, (2015) stated that the types of food plants preferred by sambar deer based on their palatability level include Echinocloa colona, Imperata cylindrica, Hymenachine amplexicaulis, Acacia mangium, Pterocarpus indicus. Meanwhile, the leading food is forage; based on research results from Suksawat *et al.* (2018), sambar deer food is dominated by the Poaceae, Clusiaceae, Cyperaceae, Euphorbiaceae and Sapindaceae families. The parts of the plant eaten by sambar deer vary, including leaves, leaves and flowers, leaves and fruit, and fruit alone. Additional feed is in pellets, bran, salt, and minerals. Every Monday, Animal Keepers usually provide additional feed for one week in the form of a small bucket of pellets equivalent to 5 kg, as well as a mixture of bran, minerals and salt in a ratio of 5:1:1. Mixing bran, salt and minerals, functions as an appetite stimulant and to meet mineral needs. The aim is to look at the feed aspect to see whether the feed that has been provided so far is ideal. After conducting direct investigations in the field, it can be said that the feed aspect in captive breeding is ideal and sound with a scale of 4 (good) with the analytical information: Provision of primary feed has been guaranteed, but the variety of feed and additional nutrition still needs to be increased to ensure optimal nutritional intake for deer from direct observation in the field.

***Aspects of Captive Management (Health Aspects)*:** According to Cripps *et al.* (2019), The health aspect of sambar deer needs serious attention so that the deer stay healthy and avoid disease. Based on the results of interviews and observations in the field, several types of diseases are known to attack deer, including bloating and diarrhoea, which deer often suffer from due to wet Food and humid air. The treatment used for bloating and diarrhoea is to add salt to the daily diet to prevent the disease as well as treat it. To prevent the spread of disease from one individual deer to another, sick sambar deer in cages are usually moved to special animal care cages (quarantine cages).

Other diseases that sambar deer often suffer from are worms, colds and loss of appetite. Worm disease in sambar deer is treated by administering a worm vaccine every six months. This is in line with the statement by Tanjung and Sibarani (2018) that worms are pretty dangerous because they can attack deer of all age classes, even though these animals have a solid resistance to worm attacks. All types of medicine and medical equipment are placed in a medicine container made of closed plastic. The worm medicine given to sambar deer at the Aek Nauli sanctuary is Ivonec. Worms often occur in deer due to unclean cage conditions or rain intensity during the rainy season. The treatment method is to give powdered worm medicine mixed with pellets. Data on recording sick sambar deer has not been well documented, making it challenging to monitor health, and there is no exceptional veterinarian to breed these deer. To increase the effectiveness of disease management and control, it is best to monitor health and record health data regularly every day or every week. Although there are several records that the sambar deer in the Aek Nauli captivity have experienced several diseases as described above, in general, the physical condition of the deer at the time this research was conducted looked healthy and in a fat condition, indicated by round ribs and buds. Scale value 3 (fair) with analysis information: Deer health monitoring is poorly documented. The availability of veterinary services also needs to be improved to deal effectively with possible health problems.

The results were obtained in the statement regarding the management of the sambar deer breeding at BPSILHK Aek Nauli, with a total of 26 statements, as shown in Table 1 above. It can be seen from the statement from the breeding management that the average score of the breeding management regarding the techniques for managing the sambar deer at BPSILHK Aek Nauli is 3.90 on a scale of 5, where this number is in the interval 3.2 to 4, which means that the management of the sambar deer breeding at BPSILHK Aek Nauli is in the high interval. The management of the sambar deer breeding at BPSILHK Aek Nauli is good, considering that this deer breeding is relatively new. Scale values are one (very low), two (low), three (medium), four

(high), and five (very high). This is expected to manage the sambar deer breeding in BPSILHK. Aek Nauli is getting betteragain in shaping its management.

Table 1. Scale value of questions about sambar deer breeding management at BPSILHK Aek Nauli.

Criteria		1	2	3	4	5	Average
Question	1	3	4	4	4	5	4.0
Question	2	2	1	4	5	4	3.2
Question	3	5	1	5	4	5	4.0
Question	4	4	2	4	5	5	4.0
Question	5	1	5	5	5	4	4.0
Question	6	3	4	4	4	5	4.0
Question	7	4	2	4	5	5	4.0
Question	8	1	5	5	5	4	4.0
Question	9	5	1	5	2	5	3.4
Question	10	2	5	4	5	4	4.0
Question	11	1	5	5	2	4	3.4
Question	12	4	2	4	5	5	4.0
Question	13	5	1	5	4	5	4.0
Question	14	2	5	4	5	4	4.0
Question	15	3	4	4	4	5	4.0
Question	16	4	2	4	5	5	4.0
Question	17	1	5	5	5	4	4.0
Question	18	3	4	4	4	5	4.0
Question	19	4	2	4	5	3	3.6
Question	20	1	5	5	5	4	4.0
Question	21	5	1	5	4	5	4.0
Question	22	4	2	4	5	5	4.0
Question	23	5	1	5	4	5	4.0
Question	24	2	5	4	5	4	4.0
Question	25	1	5	5	5	4	4.0
Question	26	4	2	4	5	5	4.0
Average							3.9
Category							Tall

***Factor supporter*:** Supporting factors in the management of this breeding area include the breeding area having sufficient area to accommodate more deer, staple food such as grass, Kananga (*Gmelina elliptica*), Danta dolo (*Homalnthus giganteus*), Kabaho Kafa (*Melastoma affine*) and Luhu (*Schoutenia ovata*) are still widely available in the area around the cage. The deer are in good health because the animal keeper always provides food service for the deer in the morning and evening, supported by the animal keeper who always cleans the cage daily. Therefore, supporting factors such as habitat management, health care and population maintenance have been fulfilled.

***Obstacle factor*:** The inhibiting factor in managing this breeding is the unavailability of veterinarians and adequate medical equipment for deer. Data on recording sick sambar deer needs to be better documented, making health monitoring difficult. Monitoring health and recording health data regularly every day or week is necessary. This can cause difficulties in diagnosing and treating deer health problems, increasing the risk of undetected or poorly treated illnesses and injuries. As a result, the health and survival of deer in captivity is threatened.

***Analysis SWOT*:** SWOT analysis is a strategic planning method used to evaluate a project's strengths, weaknesses, opportunities and threats (Benzaghta *et al*., 2021). SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) is used in deer breeding management to evaluate internal and external factors influencing breeding success. First, identify the internal and external factors for sambar deer breeding management before combining several internal and external factors into the SWOT matrix. The following is how a SWOT analysis is carried out in managing the BPSILHK Aek Nauli deer breeding.

***Identify internal and external factors*:** *Internal* and *external* factors for deer breeding management at BPSILHK Aek Nauli are as follows:

1. Strengths include the following: The cage is well maintained, the cage area is sufficient, there are shade trees, there are feed and drinking troughs, and the deer in captivity is pretty healthy.
2. Weaknesses such as lack of adequate equipment and medical equipment in the deer enclosure, inadequate stock of available medicines, absence of a veterinarian to provide necessary medical care, and lack of a record book regarding the handling of sick deer during a specific period.
3. Opportunities such as Education, conservation, research and recreation because this breeding is in a forest area with a particular purpose and is in a tourist area, it is hoped that there will be community cooperation to help maintain the cages and the presence of veterinarians from outside.
4. Threats include the introduction of viruses and diseases to deer. Animal health needs to be considered. The entry of viruses and diseases into animals threatens animals because if animals are infected with viruses and diseases, the population of animals in captivity will decrease.
5. By analyzing these four aspects, breeding management can identify strategies for exploiting strengths, overcoming weaknesses, pursuing opportunities, and dealing with threats, thereby increasing the success and sustainability of deer breeding.

The SWOT Matrix is a better strategic choice in deer breeding management because it provides the right approach to identifying specific strengths, weaknesses, opportunities and threats. With a detailed analysis of these factors, management can make more informed decisions and develop holistic strategies.

***Creation of Internal Strategy Matrix (IFAS) and External Strategy Matrix (EFAS)*:** After identifying internal and

external factors, each factor will be given a value based on the level of importance of that factor.

Table 2. Internal Strategy Factors (Strengths).

Strength	Weight	Ratings	Weight x rating
Well maintained cage	0.07	3.1	0.22
The cage area is sufficient	0.05	2.2	0.11
Adequate cage cleaning equipment	0.07	3.1	0.22
There are shade trees	0.06	2.0	0.12
There is a drinking tank	0.07	3.1	0.22
The amount of feed is sufficient	0.07	3.1	0.22
Regular feeding times	0.07	3.1	0.22
There is medicine and a health room	0.07	3.1	0.22
Healthy deer	0.07	3.1	0.22
Total (S)	0.63	3.1	0.22

Table 3. Internal Strategy Factors (Weaknesses).

Weakness	Weight	Ratings	Weight x Rating
Lack of cage maintenance and cleanliness	0.07	-3	0.22
Uneven shade trees in the enclosure area	0.06	-2	0.12
There is no feed trough	0.06	-2	0.12
Absence of additional feed and nutrients	0.06	-2	0.12
There is no water source	0.07	-3	0.12
Disabled deer	0.04	-2	0.22
Total (W)	0.37		0.89
Total (S=W)	1.00		0.89

Table 4. External Strategy Factors (Opportunities).

Opportunity	Weight	Ratings	Weight x Rating
There is a community/group that helps maintain the cage	0.13	3	0.38
Some donors provide funds for cage maintenance	0.11	2	0.21
There are plans to expand the enclosure	0.08	2	0.16
Some donors provide facilities for the cage	0.11	2	0.21
There is water assistance from groups/communities and surrounding communities	0.11	2	0.21
There is a veterinarian from outside	0.10	2	0.20
Total (O)	0.63		1.38

Table 5. External Strategy Factors (Threats).

Threat	Weight	Ratings	Weight x Rating
There are acts of vandalism from visitors or residents	0.05	-1	-0.05
There is conversion of stable land for other purposes	0.08	-2	-0.16
Visitors pollute the area around the cage	0.06	-1	-0.06
Cage equipment was stolen/ taken by visitors/ residents	0.05	-1	-0.05
Introduction of viruses and diseases in deer	0.13	-3	-0.38
Total (T)	0.38		-0.71
Total (O+T)	1.00		0.67

After getting the values from the internal and external factors, the breeding development strategy is determined by determining the coordinate points and the quadrants, then compiling a SWOT matrix table. This SWOT matrix table clearly illustrates how managers' opportunities and threats can be adjusted according to strengths and weaknesses.

According to Indrasari and Widodo (2020), the development strategy is to determine coordinate points in the following way: (Strength score + Weakness score); (Opportunity score + Threat score) (1.78 + -0.89); (1.38 + -0.71) = (0.89; 0.67)

Based on the calculation of determining the coordinate points, the results showed that the deer breeding at BPSILHK Aek Nauli was at the coordinate point (0.89; 0.67), namely in quadrant 1, which can be seen in Figure 1:

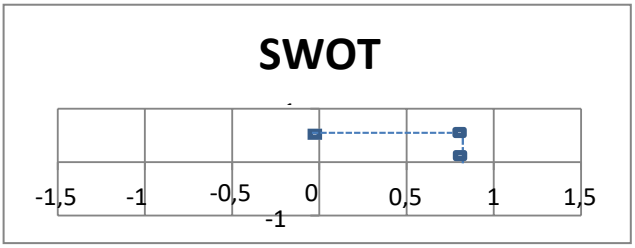

Figure 1. SWOT Matrix

Based on the picture of the position quadrant for management deer, BPSILHK Aek Nauli is in quadrant one position. It is a very profitable position Because of its own opportunityand strength so that it can be utilized opportunity Which There is. The Strategy that must be used in captive management is to support policy growth, whichis aggressive (*Growth-oriented Strategy*).

SWOT Matrix: From the results of the analysis of the use of the SWOT matrix, four alternative strategies have been obtained, including:

SO STRATEGY (0.60)

According to Maclean *et al.* (2020), the SO (Strength and Opportunity) strategy is a strategy that uses strengths to take advantage of opportunities. The alternative obtained is to care for the cage together by involving assistance from the community. Utilize a large enough cage area to add individual deer. Utilize breeding locations in tourist locations for education, conservation, research, and recreation and caring for deer so they are always healthy.

WO STRATEGY (0.16)

According to Maclean *et al.* (2020), the WO (Weakness and Opportunity) strategy is a strategy that minimizes weaknesses to take advantage of opportunities. The alternative is to involve local communities or veterinarians who collaborate with the Aek Nauli Regional Animal Husbandry Service. Such collaborations could provide opportunities to increase supplies of adequate medicines and medical equipment, expand resource networks, and increase accessibility to health services needed to maintain the welfare of reindeer in captivity.

ST STRATEGY (-0.16)

According to Maclean *et al.* (2020), the ST (Strength and Threat) strategy is a strategy that uses strength to face threats. The alternative obtained is to maintain the cage and ensure that the deer remain healthy, one of which is by providing regular Food and drink so that no deer get sick due to the entry of viruses and diseases as well as using an ample enough cage area to build a health room for the deer.

WT STRATEGY (-0.60)

According to Maclean *et al.* (2020), the WT (Weakness and Threat) strategy is a strategy that minimizes weaknesses and avoids threats. The alternatives obtained are adding medical equipment for the deer in the cage, ensuring that there is always enough water for the deer to drink and wallow, increasing the amount of feed and providing and routinely giving medicine to the deer so that the deer in the cage are not attacked by viruses and diseases and providing a health room. And a veterinarian for deer treatment.

From the description above, it can be seen that the SWOT matrix development strategy with the highest value is 0.60, namely the SO (Strength - Opportunity) strategy. The alternative obtained is caring for the cage together with the community. Utilize a large enough cage area to add individual deer. Utilize breeding locations in tourist locations as locations for education, conservation, research and recreation. Caring for deer so that they are always healthy is expected to involve collaboration between BPSILHK Aek Nauli, the community and the livestock service to make it an ideal and sustainable deer breeding facility.

***Conclusion*:** Based on the research results, a conclusion can be drawn. Namely, the management of the sambar deer breeding at BPSILHK Aek Nauli can be considered good, with a score of 3.90 on a scale of 5, indicating a relatively high level of performance. Supporting factors for reindeer breeding include sufficient breeding area and availability of adequate staple food. Meanwhile, the inhibiting factors are the absence of veterinarians and the lack of health records of sick sambar deer, which makes it challenging to monitor the health of deer in captivity. The recommended management strategy for sambar deer breeding at BPSILHK Aek Nauli is to use the SO (Strength-Opportunity) approach, with the following alternatives: improving cage maintenance, collaborating with the community, utilizing the cage area to increase the population, optimizing the breeding location as a center for education, conservation, and recreation. Collaboration between BPSILHK Aek Nauli and the livestock service is needed to make deer breeding ideal and sustainable. Recommendations for further research could be modeling sustainable reindeer breeding in the future. It is hoped that this research can improve the management of sambar deer breeding at BPSILHK Aek Nauli to a better level.

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***Conflict of interest*:** No conflict of interest is declared by the authors

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